

WHAT IS CLAIMED IS:

1. A nonvolatile semiconductor storage device provided with a capacitor using a ferroelectric thin film,
wherein:

5 an apparent coercive electric field value in an operational guaranteed temperature range of said nonvolatile semiconductor storage device, when regarded as voltage applied to said capacitor, remains within a range of design margin of said nonvolatile semiconductor
10 storage device at a coercive electric field value at a specified temperature.

2. The nonvolatile semiconductor storage device according to claim 1, wherein:

15 a rate of temperature change in an apparent coercive electric field, when regarded as the voltage applied to said capacitor, is 0.3/°C or less in the operational guaranteed temperature range of said nonvolatile semiconductor storage device.

20 3. The nonvolatile semiconductor storage device according to claim 1, wherein:

25 said ferroelectric thin film comprises a metal oxide with a phase transition point from ferroelectric to normal dielectric of 800°C or higher.

4. The nonvolatile semiconductor storage device according to claim 3, wherein:

30 said metal oxide with the phase transition point from ferroelectric to normal dielectric of 800°C or higher comprises any one of a metal oxide having a layer

structure and a metal oxide having a structure of $\text{Sr}_2\text{Nb}_2\text{O}_7$.

5. The nonvolatile semiconductor storage device according to claim 1, wherein:

5 said capacitor comprises a complex capacitor comprised of a dielectric thin film having a temperature dependency, in which a dielectric constant decreases accompanying an increase in temperature in the operational guaranteed temperature range of said
10 nonvolatile semiconductor storage device, and a ferroelectric capacitor provided with the ferroelectric thin film serially connected therebetween.

6. The nonvolatile semiconductor storage device according to claim 5, wherein:

15 said complex capacitor comprises a complex thin film showing a ferroelectric property rendered by a compounding action of the dielectric thin film having the temperature dependency wherein the dielectric constant decreases accompanying the increase in temperature in the operational guaranteed temperature range of said
20 nonvolatile semiconductor storage device, the ferroelectric thin film exhibiting the ferroelectric property in the operational guaranteed temperature range,
25 and a conductive thin film held between said dielectric thin film and said ferroelectric thin film.

7. The nonvolatile semiconductor storage device according to claim 5, wherein:

30 said dielectric thin film has the temperature dependency in which the dielectric constant decreases

accompanying the increase in temperature in the operational guaranteed temperature range of said nonvolatile semiconductor storage device comprising a relaxation type ferroelectric thin film.

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8. The nonvolatile semiconductor storage device according to claim 6, wherein:

said dielectric thin film having the temperature dependency in which the dielectric constant decreases accompanying the increase in temperature in the operational guaranteed temperature range of said nonvolatile semiconductor storage device comprises the relaxation type ferroelectric thin film.

15 9. The nonvolatile semiconductor storage device according to claim 7, wherein:

said relaxation type ferroelectric thin film comprises a metal oxide having a Perovskite structure.

20 10. The nonvolatile semiconductor storage device according to claim 8, wherein:

said relaxation type ferroelectric thin film comprises a metal oxide having a Perovskite structure.

25 11. The nonvolatile semiconductor storage device according to claim 5, wherein:

said ferroelectric thin film comprises any one of PZT expressed by $Pb(Zr_xTi_{1-x})O_3$ (where $0.1 \leq x \leq 0.8$), PZT added with La or Nb, and PZT part of Pb of which is substituted by La or part of (Zr, Ti) of which is substituted by Nb.

12. The nonvolatile semiconductor storage device according to claim 6, wherein:

said ferroelectric thin film comprises any one of

5 PZT expressed by $Pb(Zr_xTi_{1-x})O_3$ (where $0.1 \leq x \leq 0.8$), PZT added with La or Nb, and PZT part of Pb of which is substituted by La or part of (Zr, Ti) of which is substituted by Nb.

10 13. The nonvolatile semiconductor storage device according to claim 5, wherein:

said ferroelectric thin film comprises any one of

$Sr_{1-x}Bi_{2+x}Ta_2O_9$, (where $0.01 \leq x \leq 0.3$), $Sr_{1-x}Bi_{2+x}Nb_2O_9$, (where $0.01 \leq x \leq 0.3$) and $Sr_{1-x}Bi_{2+x}(Ta_{1-y}Nb_y)O_9$, (where $0.01 \leq x \leq 0.3$, $0.1 \leq y \leq 0.5$).

15 14. The nonvolatile semiconductor storage device according to claim 6, wherein:

said ferroelectric thin film comprises any one of

20 $Sr_{1-x}Bi_{2+x}Ta_2O_9$, (where $0.01 \leq x \leq 0.3$), $Sr_{1-x}Bi_{2+x}Nb_2O_9$, (where $0.01 \leq x \leq 0.3$) and $Sr_{1-x}Bi_{2+x}(Ta_{1-y}Nb_y)O_9$, (where $0.01 \leq x \leq 0.3$, $0.1 \leq y \leq 0.5$).

25 15. The nonvolatile semiconductor storage device according to claim 5, wherein:

connection between said dielectric capacitor and said ferroelectric capacitor of said complex capacitor is made with any one of a metal and a conductive metal oxide.

30 16. The nonvolatile semiconductor storage device according to claim 1, wherein:

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said capacitor comprises a thin film exhibiting a ferroelectric property rendered by a lamination of the dielectric thin film having temperature dependency in which a dielectric constant decreases accompanying an
5 increase in temperature in the operational guaranteed temperature range of said nonvolatile semiconductor storage device and the ferroelectric thin film showing the ferroelectric property in said operational guaranteed temperature range.

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17. The nonvolatile semiconductor storage device according to claim 16, wherein:

said dielectric thin film having the temperature dependency in which the dielectric constant decreases accompanying the increase in temperature in the
15 operational guaranteed temperature range of said nonvolatile semiconductor storage device comprises a relaxation type ferroelectric thin film.

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17. The nonvolatile semiconductor storage device according to claim 17, wherein:

said relaxation type ferroelectric thin film comprises a metal oxide having a Perovskite structure.

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18. The nonvolatile semiconductor storage device according to claim 16, wherein:

said ferroelectric thin film comprises any one of PZT expressed by $Pb(Zr_xTi_{1-x})O_3$ (where $0.1 \leq x \leq 0.8$), PZT added with La or Nb, and PZT part of Pb of which is substituted by La or part of (Zr, Ti) of which is substituted by Nb.

19. The nonvolatile semiconductor storage device according to claim 16, wherein:

said ferroelectric thin film comprises any one of

5 $\text{Sr}_{1-x}\text{Bi}_{2+x}\text{Ta}_2\text{O}_9$, (where $0.01 \leq x \leq 0.3$), $\text{Sr}_{1-x}\text{Bi}_{2+x}\text{Nb}_2\text{O}_9$, (where $0.01 \leq x \leq 0.3$), and $\text{Sr}_{1-x}\text{Bi}_{2+x}(\text{Ta}_{1-y}\text{Nb}_y)\text{O}_9$, (where $0.01 \leq x \leq 0.3$, $0.1 \leq y \leq 0.5$).